The Study on the Affective Computing Model of Distance Education Based on Ant Colony Algorithm

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***Abstract*—Emotion is a kind of important expression of human intelligence， and plays an important role in human decision-making process . In this paper， from the emotional characteristics， it extracted the carrier factors that influence emotions and introduced ant colony algorithm . Ants who carry the vector factor search the best emotional state to complete the task through the reaction intensity， in order to study the human emotional changes. The advanced affective computing is integrated into the distance education system so as to make up for emotion absence. The distance education system is established at the technical level on the basis of affective computing.**

Keywords- affective computing; distance education; ant colony algrithm

I. INTRODUCTION

The modern distance education raised a deep-going transformation for educational pattern and ideas; it used advanced technology and means and broke the limitation of the time, space and personnel, and made the learner study in proper time and location. It was known as an important means of establishing continuing education, long-life education and quality Education. Because the time and space was separated, modern distance education still had the defect on the affective interaction between the teachers and students. When the learner faced the computer screen for a long time and feeling no pleasure and encourage of emotion, they would got disgust, and the effective of the study would decrease. With the development of the affective computing, the distance education would blend with the affective computing. The affective computing model was established which was applied in modern distance education, and the defect of the modern distance education was made up.

In this research, the response strength value was equal with information factors, the optimal emotional status was found depending ant colony algorithm, and the varying value of the strength of the basic emotion, and the change of the emotion of the learner was checked.

From a computational point of view, all these sources are physiological signals with common difficulties of analysis and interpretation. Thus, many study concerned principally with measures of autonomic arousal, in this case skin conductance and blood volume pressure, the problems it addresses and recommendations it presents are fundamental to this vision of the future of human–computer interaction. On the face of things, some progress seems to have been made. Some scientists adopted a deliberately flawed interface designed to induce user frustration. Experimental participants played a computer game in which they were required to complete a series of visual puzzles as quickly and accurately as possible in order to win a prize of $100. At random points the game was programmed to freeze for several seconds when participants clicked to proceed to the next puzzle, as might happen with a faulty mouse or system problem. Participants' skin conductance and blood volume pressure were monitored throughout, and analysis of the signals using a pattern recognition technique was able to discriminate between periods when freezing of the game was and was not present. The paper therefore demonstrates software-induced frustration and its automatic detection by means of autonomic measures of arousal. Our own investigations have demonstrated similar software-induced changes in levels of arousal. In web-based tasks, we have found surprise events such as the sudden appearance of an alert box accompanied by a standard sound, to produce statistically significant increases in users' skin conductance. We have also found similarly significant responses to content designed to evoke an affective reaction such as amusement (Ward et al., 2002, 2003). These findings provide support for the periodically proposed idea that physiological measurement might be of use in evaluating usability or in driving interaction. In the evaluation of usability, physiological readings might help identify features that users fail to mention in feedback reports, either because they have forgotten or because they thought it insignificant.

II. BASIC IDEAS OF ANT COLOGY ALGORITHM

Ant cology algorithm was an optimal algorithm which could simulate the intelligent behavior of ant, and it had a good reliability and excellent distributed computation mechanism. The basic idea concludes the following contents. A special secretion was released during the course of the motion of the ants, and was named as information factor; the following ants could percept the existence of this substance and corresponding concentration, and preferred to move in the direction of the high concentration. The probability of choosing the route was direct proportion to the concentration of this substance. When the higher the concentration of the information factor was, the more the ants were, and the concentration of the information factor on this route was big. The high concentration could attract more ants, and a positive feedback was formed. The ant could find a optimal route depending on this positive feedback mechanism.

III. THE DESIGN OF THE AFFECTIVE MODEL

Affective computing was a new research field and a foundation established harmonious environment of human-computer. The study of affective computing was in start-up periods, and its critical technologies included physiology, psychology and activity of human

(1) Recognizing of the face expression

Recognizing of the face expression was the process of extracting the characteristic of the information of the face expression, and summarized and grasped by the means of human ideas, and the computer would carry out association, thinking and reasoning, and the emotion would be analyzed through understanding the information of human face.

There were many kinds of face expression of human, in general, the analysis of face expression would be analyzed form the analysis of dimensions and classify, the scientist Paul Ekman and other scientists divided the face expression of human into six classes: glad, surprise, dread, sorrow and angry.

The recognition of face expression of human included two techniques: the detecting and locating technology of face of human and extracting and recognizing of face image of human. There were three means to recognize the face expression of human using computer such as the method of recognizing the face expression of human based on geometry characteristic, models and the whole entities.

(2) Recognizing the voice expression

The disposal of voice expression was completed through measuring, resolving, grasping and compounding the expression components in the signal of voice, and made computer possess a certain emotional ability.

(3) The main distance education structure of the affective computing framework

A distance education depending on affective computing, as a teacher, was a computer-based educational system that would offer effective instructions. It had been demonstrated that an experienced human tutor manages the emotional state (besides the pedagogical state) of the learner to help him and amend the learning process. Therefore, the student model structure needs to be augmented to include knowledge about the affective state. The distance education of affective computing framework possessed the performance of reasoning about the affective state to provide students with an adequate response from a pedagogical and more precisely affective point of view; that was why we needed the affective e-learning system that it had two main functions: (1) to infer the affective student state; and (2) to construct the optimal tutorial action considering the student affective state. In this means, the new affective distance education framework was established that was shown in Figure 1. In Figure 1, DB1denoted data base of the student model, DB2 denoted data Base of the tutorial model, and KB denoted knowledge base of the teacher agent.

It improved learning within our virtual learning environment depend on a more personalized environment through confirming the students' affective state with the aim of reacting appropriately from a pedagogical and affective point of view. The affective system considered the student emotion and the tutorial situation to form the affective action. The affective action made the tutor establish the next pedagogical action based on the knowledge base, and it also made the curriculum agent found the physical realization of the pedagogical action.

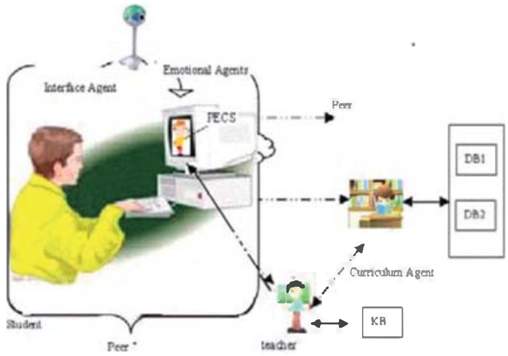

Figure 1. The distance education framework established by affective computing

We developed the internal state of the EECA depended on the PECS model because agents were virtual human beings. They were designed to imitate or model human behavior. Human behavior was complex with several sides. Nevertheless, it was possible to argue that human behavior could within limits be modeled and could thus be made comprehensible and predictable. Physical, emotional, cognitive, and social factors occurred in all forms of human behavior. Approaches, which considered human beings exclusively as rational decision makers, are of limited value. The modeling of human behavior played an important role in all areas in which action planning, decision-making, social interacting and such as play a part. These were the four main building blocks of a particular PECS agent framework adding a Sensor- Perception module and a behavior-actor module. PECS's agent model consisted of three horizontal layers:

1. Information Input Layer: This layer processes the input taken from the agent environment and consists of two components:

The Sensor and Perception components: The sensor component takes the external data by means of a set of sensors and the Perception component filters the irrelevant data and processes the information. The perceptions are used to update the mental state of the agent or for learning purposes.

2. Internal Components Layer: The personality of the agent is modeled at the second layer. Thus, the parameters of this second layer are crucial to find out the response of the agent to the input taken by the information layer. They consist of four components: Physics, Cognitive, Emotional, and Social Status. The physical and material properties of the agents are modeled in the Physical component. The emotions that can affect the behavior of the agent are modeled as part of the Emotional component. The agent's experience and knowledge are part of the Cognitive component and finally the social features of the agent (e.g., whether the agents like

to socialize or they prefer to be alone) are described in the social status component.

3. Agent Output Layer: This layer is in charge of modeling the set of possible actions and the selection process, and thus it produces the response of the agent and consists of two components: The behavior and actor components. The behavior Component selects the actions that are associated with the input information that reaches the agent and the agent's response is based on its internal parameters. The actor component takes the actions and executes them. The PECS architecture is not based on any social or psychological theory. The architecture is mainly an integrated model in which several fundamental aspects to human behavior and decision-making process are taken into account. The purpose of the emotional agents consists of extracting the learner's facial expressions (acquisition and facial alignment) and subsequently categorizing them using the temporal evolution of distances Di as it is demonstrated in Table 1.

TABLE I. THE RELATIONSHIP BETWEEN ALL KINDS OF EMOTIONS AND THE DI

	Joy	Sadness	Anger	fear	surprise
D1	=	↑	↑	↑	=
D2	=	=	↑	=	↑
D3	↑	↑	=	↑	=
D4	↑	=	↑	↑	↑
D5	↑	=	=	=	↑
D6	=	↑	↑	↑	=

The analysis of Table 1 showed that it would be possible to differentiate between different emotions while being interested in priority in the Di distances which undertake significant modifications. Indeed, there was always at least one different evolution in each scenario.

IV. ROBOT AFFECTIVE MODEL

(1) The euclidean distance of different emotions

The euclidean distance of the five emotions mentioned above was shown in Table 1, seen from the table, the euclidean distance between different emotions was bigger, and the euclidean distance between same emotions was smaller. The euclidean distance of fear was lest, and the euclidean distance of the anger was biggest.

TABLE II. THE RELATIONSHIP BETWEEN ALL KINDS OF EMOTIONS AND THE DI

	Joy	Sadness	Anger	fear	surprise
Joy	11.2	34.5	38.4	48.3	42.1
Sadness		12.6	36.5	54.3	41.4
Anger			12.2	46.5	34.6
fear				7.69	65.6
surprise					15.3

(2) Affective model based on ant colony algorithm

The choosing emotion would be connected with ant finding route, and the many advantages of ant colony algorithm was used. The affective model would be constructed based on ant colony algorithm. The model could be expressed as follows:

$$p_{uv}^{k} = \frac{[\pi_v]^{\alpha}[\lambda_{uv}]^{\beta}}{\sum\limits_{w\in l(u)}[\pi_v]^{\alpha}[\lambda_{uv}]^{\beta}} \tag{1}$$

where p_{uv}^{k} was probability of transfer; u , v denoted different emotion states; k was factor of delivering; λ_{uv} was degree value of wish transfer from u to v , and could be defined as follows:

$$\lambda_{uv} = \frac{1}{d_{uv}} \tag{2}$$

α was relative important value of the response strength, general equal to 0.7; β was relative important value of degree of transfer wish, general equal 0.3.

The update formula of response strength in state v was given as follows:

$$\pi_v(t+1) = \rho\pi_v(t) + \Delta\pi_v(t) \tag{3}$$

where ρ was the decay rate of response strength in the state v , $\Delta\pi_v(t)$ was the increment of response strength in the state v , which could be calculated according to formula (4).

$$\Delta\pi_v(t) = I_v \times \pi_v \tag{4}$$

where $I_v = (I_1,\ I_2,\ I_3,\ I_4,\ I_5)$ was exciting vector; π_v was component of response strength vector.

(3) The affective model agent

The tutor's role was the following areas:

To ensure the follow-up of the training of each learner;

To support learners in their activities;

To support the human relations and the contacts between learners;

To seek to reinforce the intrinsic motivation of learner through its own implication from the guide who shares the same objective. These interventions aim at the engagement and the persistence of learner in the achievement from its training;

To explain the method of training and to help to exceed the encountered difficulties;

To help learner how to evaluate his way, his needs, his difficulties, his rhythm and his preferences; The tutoring agent achieves pedagogical expertise on the learner because he has knowledge taught on the field (theoretical knowledge and practical skills). His diagnoses are based not only on the session learning courses, but also on the learner historic actions. It may make requests to the model of the learner (through the Curriculum agent) to find out his history and proceed to the necessary strategy. In his diagnoses, the tutoring agent is based on the results of evaluations provided by the Curriculum Agent, as well as indications of EECA (which provides information on the emotional state of the learner). These data are analyzed to decide the need for its urgent intervention mainly due to a situation of panic or stress (or stop using the simulation) and save all diagnoses for later use. At the end of the e-learning session:

It updates the assessment curves and calculates the final score and delivered its report;

It took the decision on the next exercise to achieve.

(3) Interface agent

Their role is to act as mediators between the human and the computer cyberspace and to be capable of personalizing an interface by monitoring and sensing individuals capabilities, interests, and preferences.

An interface agent can also be a service agent with a particular role. It can communicate and negotiate with other agents in a multi-agent system to determine which and how services are to be provided.

Transmit the facial information coming from the learner to the other agents of the Multi-Agents System.

Assign the achieved actions and information communicated by the learner, to curriculum agents, the emotional agents.

V. THE RESULTS

(1) The interaction among agents

The interaction among human agents is not restricted to the proposed computational model. On the contrary, the computational interaction among the artificial agents aims at contribution even more for the communication and the exchange among the human agents. The interaction will be one of the main goals of this model because the proposal is about a model of collaborative learning. The several interaction forms involved in the model are interaction among artificial agents, interaction among artificial and human agents, and interaction among human agents. In respect to communication among the human agents, the system offers tools (synchronous or asynchronous) when physical presence is not possible (for example, in the case of virtual classes).

There are several reasons which justify the interests of this Meta Model. The main reasons are the following: (i) it is possible to construct secure systems using groups viewed as "black boxes" because what happens in a group cannot be seen from agents that do not belong to that group. (ii) It is possible to construct dynamic components of system when we view the system as an organization where agents are components. Adding a new group or playing a new role may be seen as a plug-in process where a component is integrated into a system. (iii) Semantic interoperability may be guaranteed using roles because a role describes the constraints (obligations, requirements, and skills) that an agent will have to satisfy to obtain a role.

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